IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

M04/411/H(3)

BIOLOGY
HIGHER LEVEL
PAPER 3

Candidate number

Wednesday 12 May 2004 (morning)

1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

- Write your candidate number in the box above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the Options in the spaces provided. You may continue your answers on answer sheets. Write your candidate number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the candidate box on your cover sheet and indicate the number of answer sheets used in the appropriate box on your cover sheet.

Option D – Evolution

D1. A meteorite that struck near Murchison, Australia was analyzed for the presence of amino acids. Similar studies have been carried out on liquid samples taken from the Miller-Urey discharge experiment. The table below summarizes the results from both sources. Each dot represents a relative amount of a particular amino acid, with one dot representing a small amount and eight dots representing a large amount.

Amino Acid	Murchison Meteorite	Miller-Urey Experiment
Glycine	••••••••	••••••••
Alanine	••••••••	••••••••
α-amino-*N*-butyric Acid	••••••	••••••••
α-aminoisobutyric Acid	••••••••	••••
Valine	••••••	••••
Norvaline	••••••	••••••
Isovaline	••••	••••
Proline	••••••	••
Pipecolic Acid	••	•
Aspartic Acid	••••••	••••••
N-ethylglycine	••••	••••••
Sarcosine	••••	••••••

[Source: C Mitchell, *Life in the Universe*, (1995), W H Freeman, pages 46–47]

(a) State the theory for which the Murchison meteorite provides evidence. *[1]*

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(b) Compare the amino acids found on the meteorite with those produced in the Miller-Urey experiment. Refer to named examples. *[3]*

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(This question continues on the following page)

(Question D1 continued)

(c) Suggest a conclusion from your comparison. *[1]*

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D2. (a) Outline **one** disease that can occur as a result of gene mutation. *[2]*

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(b) (i) State the Hardy-Weinberg principle. *[1]*

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(ii) List the conditions under which the Hardy-Weinberg principle applies. *[2]*

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D3. (a) Evaluate Lamarck's theory for the origin of species. *[4]*

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(b) Discuss the relative contributions of genetic and cultural evolution in the evolution of humans. *[6]*

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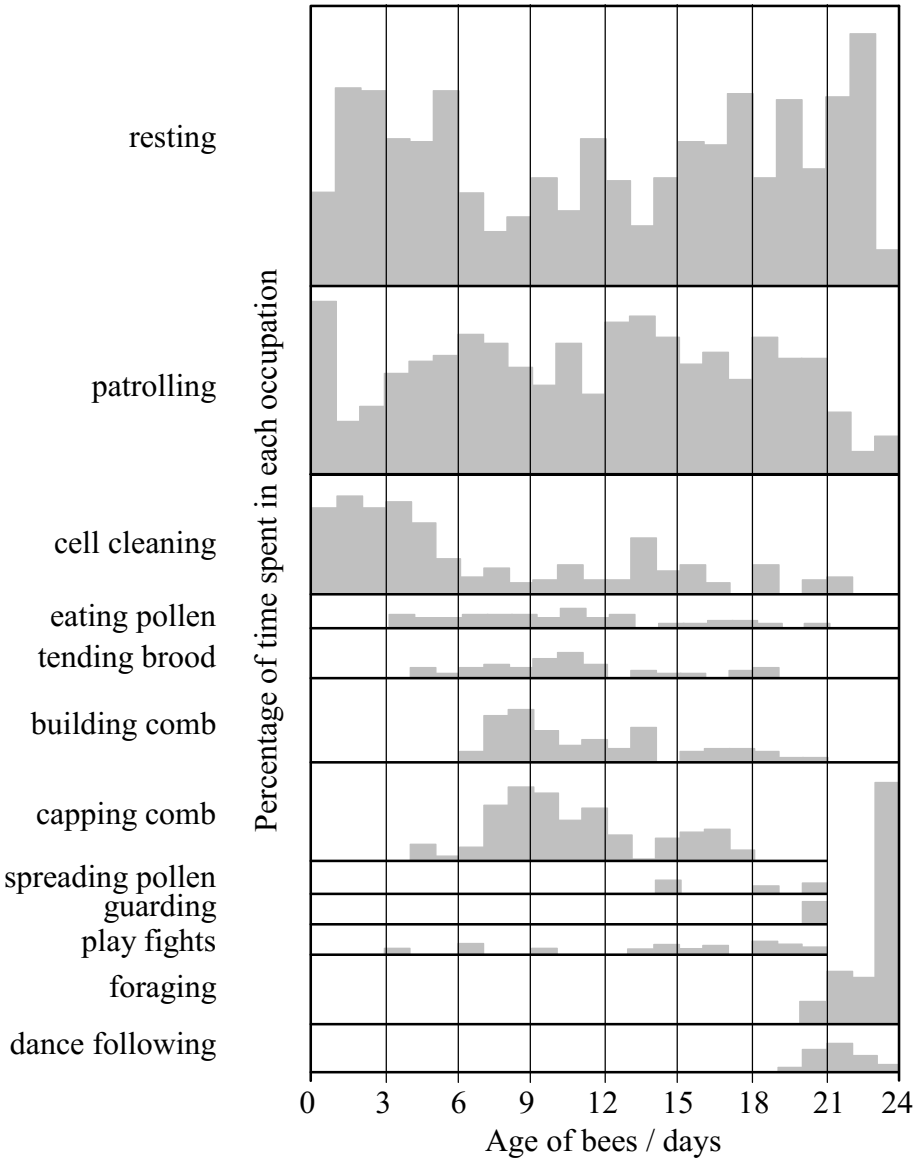
Option E – Neurobiology and Behaviour

E1. During the first 24 days, worker bees *(Apis millifera)* go through a series of occupational specializations. The diagram below is a record of the first 24 days in the life of one worker bee. Adding the heights of the bars for a particular day gives 100 % of the activity for that day.



[Source: J L Gould, *Ethology*, (1982), Norton, page 392]

(a) (i) Determine the percentage of time the bee spent on cell cleaning on day 1. *[1]*

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(ii) Calculate the ratio of time spent foraging to the time spent patrolling on day 24. *[1]*

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(This question continues on the following page)

(Question E1 continued)

(b) Identify the **two** most common activities of the bee over the 24 days. *[1]*

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(c) Other than resting and patrolling, describe the changes in the bee's activities over the 24 days. *[3]*

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(d) Suggest why patrolling is a social behaviour. *[1]*

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E2. Outline Pavlov's experiments on the conditioning of dogs. *[3]*

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E3. (a) Outline the behavioral effects of cannabis and alcohol. *[4]*

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(b) Explain how pre-synaptic neurons can either encourage or inhibit post-synaptic transmission. *[6]*

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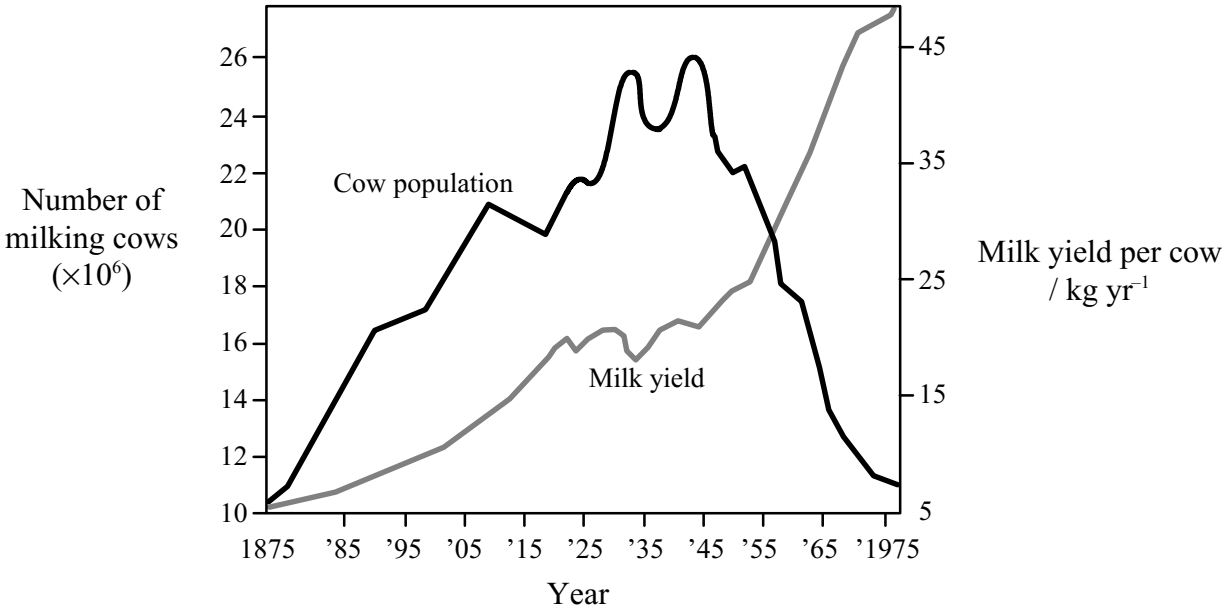
Option F – Applied Plant and Animal Science

F1. The graph below shows how the milk yield per cow and the cow population have changed over the one hundred year period between 1875 and 1975 in the United States.



[Source: J T Reid, "Progress in Dairy Cattle Production", *Agriculture and Food Chemistry: Past and Present and Future*, R Teranishi (edition) Westport Conn: Avi Press (1978)]

(a) Calculate the percentage change in the number of cows from 1945 to 1975. *[1]*

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(b) Compare changes in milk yield per cow and cow population from 1875 to 1975. *[2]*

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(c) Suggest why milk yield has changed. *[2]*

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F2. (a) Explain the role of auxin in phototropism. *[3]*

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(b) Describe how plant growth regulators can be used commercially to produce fruits without seeds. *[2]*

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F3. (a) Draw a labelled diagram of a monocotyledonous wind-pollinated flower. *[4]*

(b) Explain how manipulation of day length is used in the production of flowers. *[6]*

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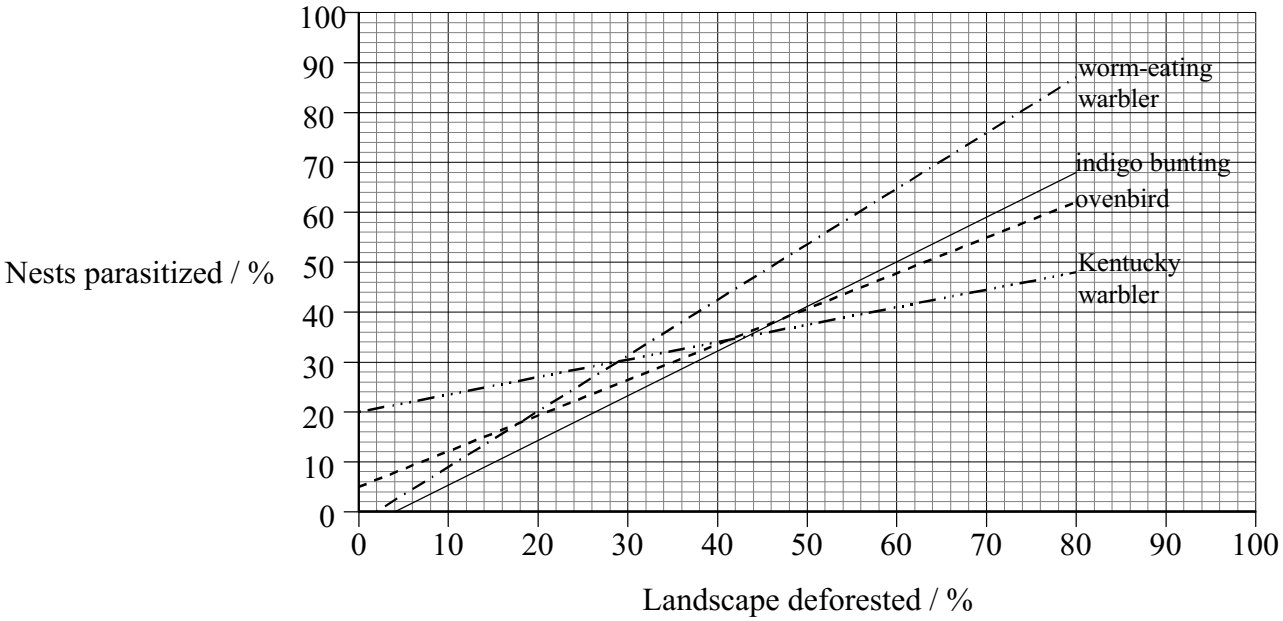
Option G – Ecology and Conservation

G1. The brown-headed cowbird *(Molothrus ater)* is a parasitic bird that lays its eggs in the nests of other species. The parasitized hosts often raise the resulting cowbird offspring as their own. The true offspring may starve while the larger cowbird offspring consume most of the food brought by the parents.

The preferred habitat of the brown-headed cowbird is open agricultural areas.

The results of a study into the effects of deforestation on cowbird parasitism of four different host species are shown below.



[Source: S K Robinson, *et al*, (1995), *Science*, **267**, pages 1987-1990]

(a) State the effect of deforestation on cowbird parasitism. *[1]*

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(b) Compare the effect of deforestation on cowbird parasitism of the worm-eating warbler and the Kentucky warbler. *[2]*

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(c) Determine the percentage of worm-eating warbler nests parasitized by cowbirds at a level of 60 % deforestation. *[1]*

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(This question continues on the following page)

(Question G1 continued)

(d) Suggest reasons for the relationship between deforestation and cowbird parasitism. *[2]*

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G2. (a) Outline the use of the Simpson diversity index. *[3]*

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(b) Explain the use of biotic indices and indicator species. *[6]*

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G3. (a) Draw a labelled diagram of the nitrogen cycle. *[3]*

(b) State **two** fuels that can be produced from biomass. *[2]*

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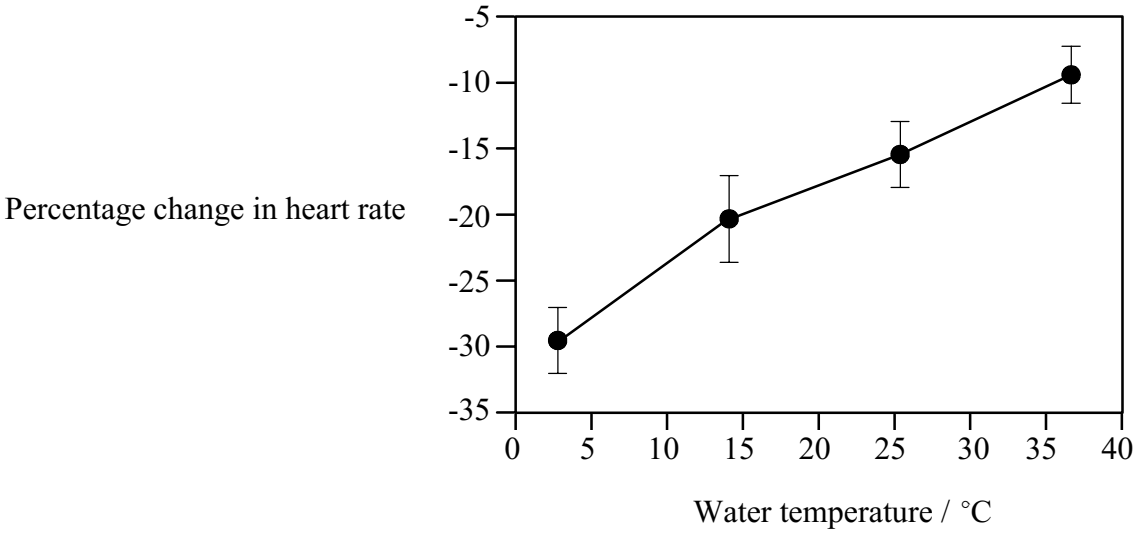
Option H – Further Human Physiology

H1. Marine mammals have a series of physiological responses to diving. This enables them to stay submerged for long periods in water colder than their body temperature. Collectively these responses are termed the diving reflex.

To investigate the diving reflex in humans, heart rate changes in ten healthy subjects were monitored during facial immersions in water ranging from 3 °C to 37 °C. The data for this experiment is shown below.



[Source: N R York, *Effect of Water Temperature on Diving Reflex Induced Bradycardia in Humans*, http://kesler.biology.rhodes.edu/sciJ/York.html]

(a) (i) State the effect of facial immersion on heart rate over the range of temperatures shown on the graph. *[1]*

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(ii) Suggest **one** reason for the relationship between facial immersion and heart rate. *[1]*

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(b) Outline the effect of the water temperature on heart rate. *[1]*

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(This question continues on the following page)

(Question H1 continued)

(c) Calculate the heart rate of a person immersed in water at a temperature of 15 °C, if their heart rate before immersion was 70 beats per minute. *[2]*

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H2. (a) List **two** glands that secrete digestive juices into the alimentary canal. *[1]*

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(b) Describe the process of erythrocyte and hemoglobin breakdown in the liver. *[4]*

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H3. (a) Discuss factors which affect the occurrence of coronary heart disease. *[7]*

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(b) Explain the way the body acclimatizes to gas exchange at high altitudes. *[3]*

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